



## DESIGN AND IMPLEMENTATION OF EVIDENCE COLLECTION SYSTEM FROM EVENT DATA RECORDER FOR CAR CRASH ANALYSIS

Amarnath S. Kale<sup>1</sup>, Prof. P.H.Chandankhede<sup>2</sup>

<sup>1</sup>Research Scholar, Department of Electronics and Telecommunication Engineering, G.H. Raisoni College of Engineering Nagpur, India.

<sup>2</sup>Assistant Professor, Department of Electronics and Telecommunication Engineering, G.H. Raisoni College of Engineering Nagpur, India.

**Abstract:** - This paper describes the effective way of retrieving data collected by event data recorder whenever accident occurred or crash detected. The Event Data Recorder (EDR) is one of the favourable solution for public safety. This event data recorder is composed of various sensors which are interfaced with processor for collecting vehicle status. This evidence collection system is nothing but the software based system which will collect data from EDR, process it and show the exact cause of accident. Graphical user interface (GUI) is constructed using Visual basic VB .NET software which shows readings of all sensors at the time of accident. This helps to design safer vehicles, driver behaviour system, clear technical faults, issuing driving license, etc. This system can be implemented into any vehicle all over the world.

**Keywords:** - Event Data Recorder; GUI; Vehicle Monitoring; Evidence Collection system; crash analysis.

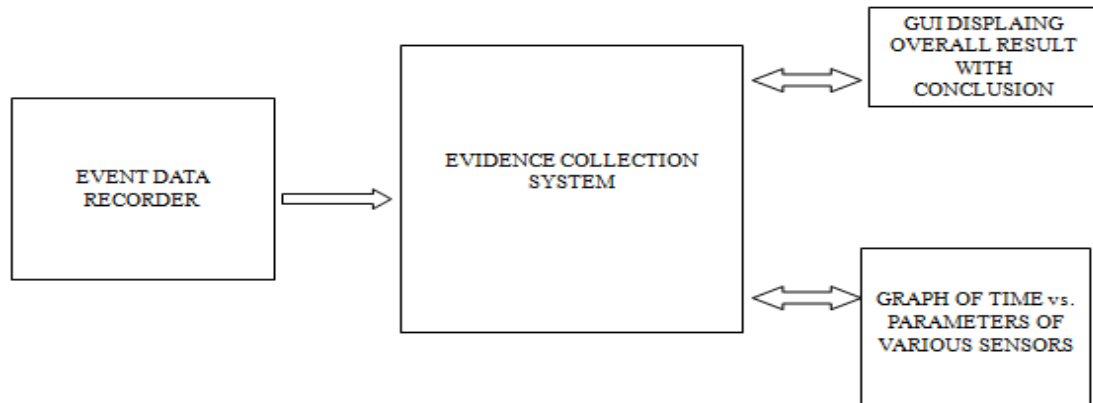
### I. INTRODUCTION

Currently traditional method of crash analysis is being used in which cops need to visit accident site and check for signs of accident. Then they need to check for evidences like skid marks, degree of damage, collision part, eye witness etc. Often, there is situation of insufficient evidences. Sometimes it may also possible that some clues got missed by police. This is very time consuming and complex process. By using this evidence collection system we could perform analysis of accident cases just from police station. This reduces manpower, time and complexity over traditional system. Results obtained from analysis may also useful in driver training purpose, safety purpose, insurance issuing process etc. An Event Data Recorder is a device which is installed in vehicles to record information related to vehicle crashes or accidents. EDR is also commonly known as the "Black-Box". In recent time vehicles like trucks, cars etc. black boxes are activated or triggered by the problems sensed by the electronic components like sensors. These problems are also known as the electronically sensed Problems. Black Box preparedness to collect the statistically applicable crash or accident information to improve the safety of the vehicles. This collected information is stored micro SD memory card. This memory card is that much capable to store all data.

This system satisfies objectives which are, To build such an Evidence collection system which could construct clear picture of an accident, To design an Evidence collection system which will reduce time and complexity in police verification and accident analysis process, To provide sufficient memory space to store event data in form of micro SD memory storage card, To prevent falsification of data stored in memory card. There could be cases of data forgery or data modification and To construct such Evidence Collection System which helps in insurance cases. Hence this system is not focused on certain objective only. There are many things which can be achieved by this system. To store all data recorded by EDR, here we are using excel sheet. Using excel sheets huge capacity, we don't need to rewrite data.

## II. SYSTEM ARCHITECTURE

### A. Block Diagram



*Figure 1. Block Diagram of Evidence Collection System*

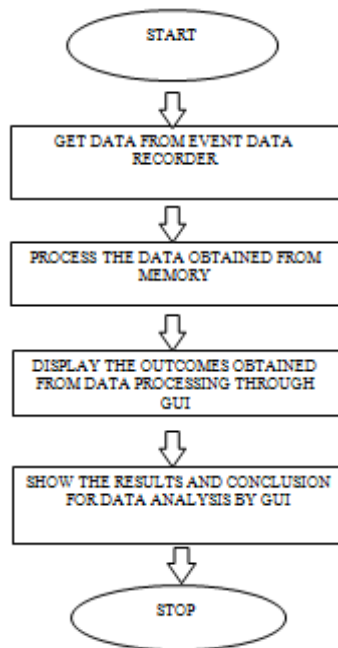
As shown by block diagram, this system collects data from event data recorder and shows results using GUI. It's no more complexity. Just simple and convenient design is this.

A	B	C	D	E	F	G	H	I	J	K	L	M
Date	Time	TEMPERATURE(Degree)	DISTANCE(feet)	SPEED(kmph)	IMPACT(KPa)	BRAKE PRESSURE(Pa)	TYRE PRESSURE(KPa)	LATITUDE	LONGITUDE	SEAT BELT WORE	AIRBAG	
11-02-2016	10:23:06	63	11	17	0	0	238	84.173	37.764	YES	NOT OPEN	
11-02-2016	10:23:09	63	0	82	0	5	239	83.629	36.543	YES	NOT OPEN	
11-02-2016	10:23:12	65	3	79	0	0	240	82.902	36.432	YES	NOT OPEN	
11-02-2016	10:23:15	68	7	21	0	0	242	82.438	36.104	YES	NOT OPEN	
11-02-2016	10:23:18	69	10	43	0	32	242	82.023	35.875	YES	NOT OPEN	
11-02-2016	10:23:21	73	14	48	0	0	242	81.781	35.275	YES	NOT OPEN	
11-02-2016	10:23:24	78	11	54	0	40	242	81.522	35.041	YES	NOT OPEN	
11-02-2016	10:23:27	82	9	56	0	12	242	80.991	34.994	YES	NOT OPEN	
11-02-2016	10:23:30	86	12	61	0	0	242	80.627	34.156	YES	NOT OPEN	
11-02-2016	10:23:33	91	14	65	0	10	242	80.172	33.853	YES	NOT OPEN	
11-02-2016	10:23:36	93	8	59	0	9	242	79.821	32.716	YES	NOT OPEN	
11-02-2016	10:23:39	93	13	61	0	0	242	79.288	32.152	YES	NOT OPEN	
11-02-2016	10:23:42	94	9	58	0	0	242	79.124	31.365	YES	NOT OPEN	
11-02-2016	10:23:45	94	12	52	0	5	242	78.403	30.748	YES	NOT OPEN	
11-02-2016	10:23:48	94	15	50	60	2	242	77.659	30.898	YES	OPEN	

*Figure 2. Input data to be process by system*

The above figure shows data stored in micro SD memory card. Parameters in this data are engine temperature, distance from front vehicle, latitude, longitude, seat belt status, speed of vehicle, airbag status, tyre pressure, Impact pressure, Brake pressure etc. Like this excel file is used to save whatever data collected by sensors. This data is collected after every 3 seconds. If we drive vehicle 14 hours per day, then 1048576 rows of excel sheet will collect data of 62 days in 55 MB only. Then by using a 500 MB micro SD memory card, we can collect data of a whole year. This shows that how excel sheet is useful to store data recorded by event data recorder.

## B. Flow Chart



*Figure 3. Flow Chart of Evidence Collection System*

As from block diagram, this system first fetches data from EDR. This is nothing but the recordings of various sensors while vehicle is running. Then Evidence Collection System processes this data. This data is organized in tabular form. Then we get outcomes such that comparison of Time Vs Speed, Time Vs steering angle, Time Vs Temperature etc. After all this data processing, system tells exact cause/causes of accident. For that system checks threshold value of individual sensor. If a particular sensor has crossed threshold value, it's a cause of accident.

This system depends on continuously recording based EDR. This may need large amount of memory to store data. But, by using excel files this problem is solved. Then also we are using micro SD memory card of largest storage capacity to save this data. Data retrieval and analysis of recorded data is done through GUI which is prepared from Microsoft Visual Basic .Net (VB .NET). All information collected by sensors is shown by this GUI. This ECS system works at three interdependent levels.

**Data Collection Level:** At this level, data from different sensors are collected and stored in SD card. For this ARM processor is interfaced with all sensors. **Data Processing Level:** This is the main level where data from SD card is retrieved and processed. Various information required for post crash analysis is obtained here. **Human interference window:** At this stage all processed data is made available for manual analysis. A separate GUI is constructed for this.

## C. Breadth First Search -Technique

Now there is have huge data collected by all sensors. There must be a data mining algorithm which could handle this all data very effectively. That's why Breadth First Search technique is used here. This is most reliable search technique than any other.

$$A = \begin{pmatrix} A_{1,1} & \dots & A_{1,p_c} \\ \vdots & \ddots & \vdots \\ A_{p_r,1} & \dots & A_{p_r,p_c} \end{pmatrix}$$

**Figure 4. Data mining in Breadth First Search**

As shown in figure, this technique maps data by row and column. Initially it selects first row. Then data on all columns of first row are mapped into system. Then again same technique for second row. Likewise all data of micro SD memory card is fetched into system. By this speed of system increases and dependability of system on external devices is reduced.

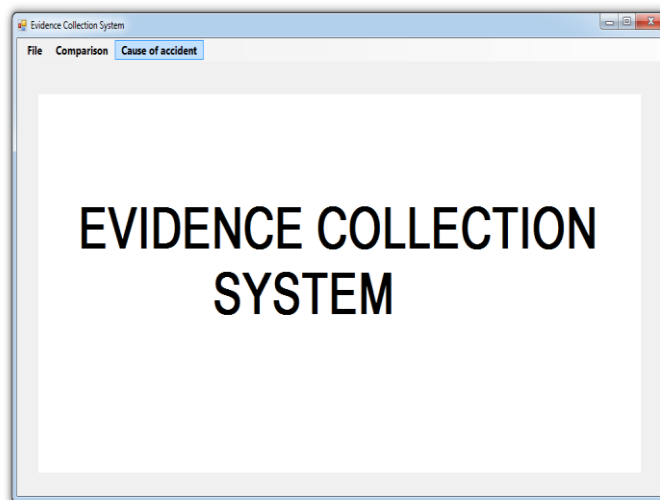
### III. SOFTWARE DESCRIPTION

#### A. Microsoft Visual Basic:

VISUAL BASIC also known as VB is a high level programming language. It is evolved from the earlier programming language in the DOS version called as the BASIC. BASIC is the abbreviation for Beginner’s All-purpose Symbolic Instruction Code. The Visual Basic programming codes resembles the English language. Different software companies generate the different versions of BASIC like Microsoft GWBASIC, QBASIC, QUICKBASIC, IBM BASICA and much more. It is too easy programming language to learn and for anybody interested in programming but have a less knowledge of professional training in software engineering.

### IV. RESULTS

We got different graphs showing sensor values with respect to time. These graphs are shown below using snapshots. This GUI contains two main windows. Both of these windows are as below.



**Figure 5. Home page of GUI**

This is first page when GUI opens. Again it contains different sub-links connected. File option allows to select excel file from SD card. After selection of excel file from SD card, all data is mapped into new window of GUI. By this option we can select any file for analysis.

F1	F2	F3	F4	F5	F6	F7	F8	F9
Date	Time	TEMPERATURE	DISTANCE(feet)	SPEED(kmph)	IMPACT(KPa)	BRAKE PRESSU...	TYRE PRESSU...	LA
11-02-2016	10:23:06	63	11	17	0	0	238	84
11-02-2016	10:23:09	63	0	82	0	5	239	83
11-02-2016	10:23:12	65	3	79	0	0	240	82
11-02-2016	10:23:15	68	7	21	0	0	242	82
11-02-2016	10:23:18	69	10	43	0	32	242	82
11-02-2016	10:23:21	73	14	48	0	0	242	81
11-02-2016	10:23:24	78	11	54	0	40	242	81
11-02-2016	10:23:27	82	9	56	0	12	242	80
11-02-2016	10:23:30	86	12	61	0	0	242	80
11-02-2016	10:23:33	91	14	65	0	10	242	80
11-02-2016	10:23:36	93	8	59	0	9	242	79
11-02-2016	10:23:39	93	13	61	0	0	242	79
11-02-2016	10:23:42	94	9	58	0	0	242	79
11-02-2016	10:23:45	94	12	52	0	5	242	78
11-02-2016	10:23:48	94	15	50	60	2	242	77

Figure 6. Data mapped from SD card.

This comparison option allows to compare sensor parameters with respect to time. Like Speed Vs. Time, Engine Temperature Vs. Time, Brake Pressure Vs. Time, Distance Vs. Time, Tyre Pressure Vs. Time. Last one, cause of accident option gives exact cause of crash. There can be one or more causes for an accident.

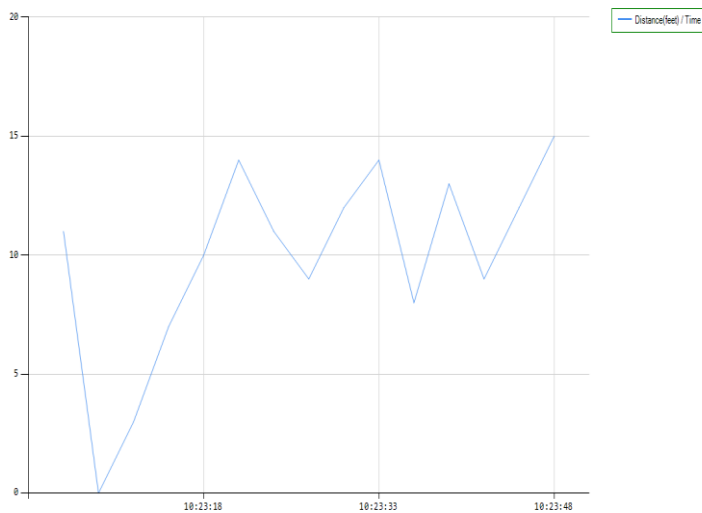
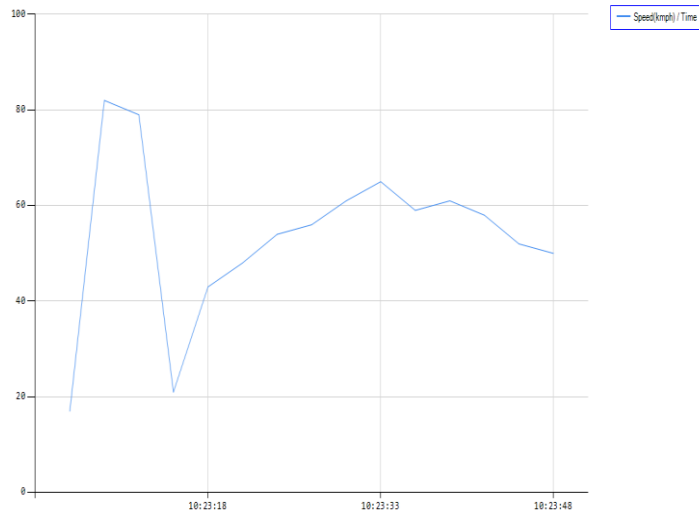


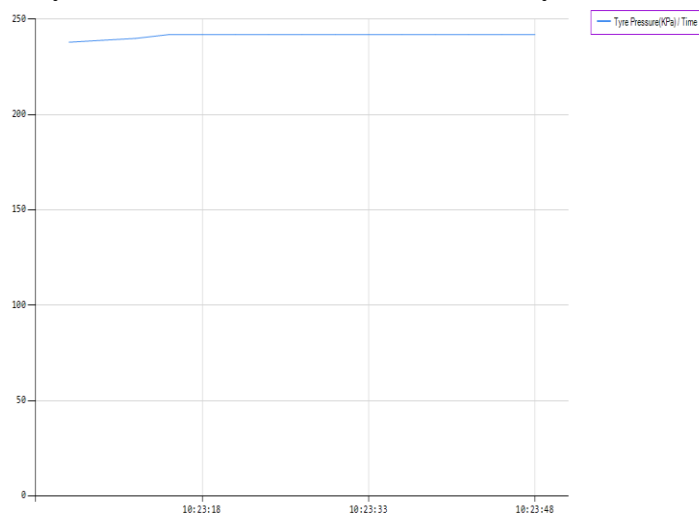
Figure 7. Data mapped from SD card.

Sufficient distance must be maintained between our vehicle and front vehicle. This graph shows distance between our vehicle and next vehicle. This distance is in feet. By this graph we can find, did driver maintain sufficient distance or not? Lower value in graph shows that, driver was about to collide on front vehicle.



**Figure 8. Graph of Speed Vs Time**

This graph shows speed by which vehicle has been driven. We can compute driver behaviour model by this. In this driver behaviour model we will set threshold limit for speed and whenever driver will cross this threshold, graph with date, time and speed will be displayed. How rashly driver drives can be detected here. For this system uses data collected and stored by Accelerometer.



**Figure 9. Graph of Tyre Pressure Vs Time**

This graph shows actual tyre pressure with respect to time. Normally tyre pressure range varies between 230 to 270 Kpa. Tyre gets burst at 300 KPa. This will collect information regarding to highest tyre pressure in any of the tyre. So, if accident happened due to tyre burst, we could get evidence of tyre burst and exact tyre pressure before accident.

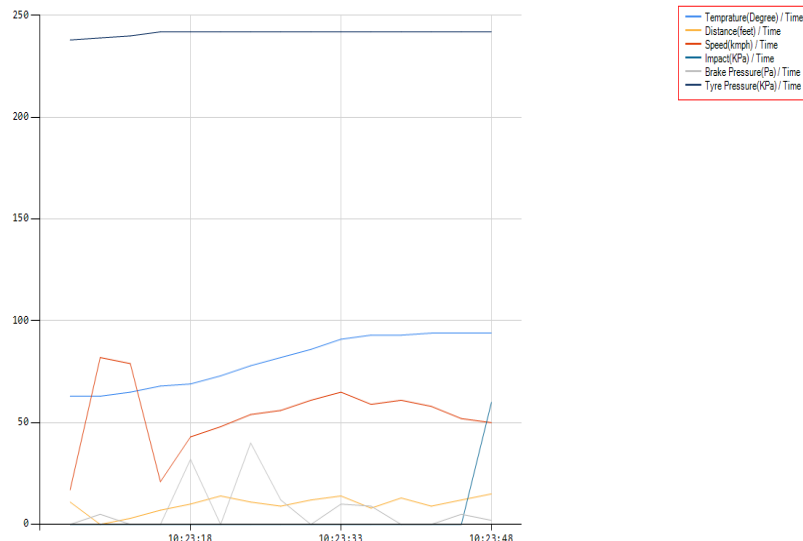


Figure 10. All parameters in a single graph

This is a graph showing all parameters in a single view. All parameters are shown here as per their values with respect to time. By this, we don't need to see each single graph for reading at particular time.

## V. APPLICATIONS

These analysis results are useful in various cases.

### A. Police verification

Results obtained are important in case of police verification. Cops can use these results as evidences and solve accident cases very effectively. This gives justice to victims.

### B. Driving license issuing

Driving license issuing authorities can check performance of driver using this system. If certain driver has poor performance regarding to driving, particular action can be taken by authorities. This helps to award license for skilled drivers only and to minimize road accidents.

### C. Driver behaviour model

A car owner or transportation company owner can check how his driver used to drive vehicle. Comparison analysis can show fluctuations in speed, temperature, steering angle etc. This helps owner in driver behaviour analysis model.

## VI. CONCLUSION

“Design and Implementation of Evidence Collection System from Event Data Recorder for Car Crash Analysis”, paper deals with results obtained from advanced Event Data Recorder for fault protection in vehicle to get data recorded. Also this paper aims to provide the actual cause of the accident or crash of the vehicle by retrieving the data from the EDR. Graphical comparison of various parameters such as tyre pressure, speed, brake pressure, engine temperature, distance, impact pressure with respect to time is also done. Time wise analysis of particular sensor is much easier due to these results.

These results are also helpful in cases like Driver training program, Insurance cases, Police verification etc.

## REFERENCES

- i. [1] Shital V. Vaidya, Prof. P. H. Chandankhede, “Designing of Event Data Recorder for Vehicle Monitoring based on ARM Processor” International Conference On Emerging Trends in Science, Engineering, Business and Disaster Management ICBDM 2014, Image Processing and Networking Volume:8 Special Issue IV, Feb 2014, ISSN No:0973-2993

- ii. Nitin P. Sirsikar, Prof. P. H. Chandankhede, "Design of ARM based Enhanced Event Data Recorder & Evidence Collecting System", IOSR Journal of Electronics and Communication Engg. (IOSRJECE) e-ISSN: 2278-2834, p-ISSN: 2278-8735. Volume 9, Issue 5, Ver. V (Sep -Oct. 2014), PP 23-29
- iii. Monisha J Prasad, Arundathi S, Nayana Anil, Kariyappa B. S., "Automobile Black Box System For Accident Analysis", International Conference Of Advances In Electronics, Computers and Communications (ICAECC) 2014.
- iv. Pravin kumar, V. Anuragh, NLP Raju, "Accelerometer Based Vehicle Monitoring And Tracking System Using ARM Processor and GPS", International Journal of Science, Engineering and Advance Technology, IJSEAT, Volume 2, Issue 11, ISSN 2321-6905 November-2014.
- v. Anoop Mathew, Joseph Kuncheria, Yadukrishnan S, Gifty Raju, Haritha Chandrasekhar, "Car Black Box", International Journal of Innovative Science and Modern Engg. (IJISME) ISSN: 2319-6386, Volume-2 Issue-11, October 2014
- vi. Kangsuk Chae, Daihoon Kim, Jaeduck Choi, and Souhwann Jung, "Evidence Collecting System from Car Black Boxes", School of Electronics Engg, Soongsil University, Seoul, Korea 2013.
- vii. Mooseop Kim and Chi Yoon Jeong, "An Efficient Data Integrity Scheme for Preventing Falsification of Car Black Box", ICTC pp. 1020-1021, 2013
- viii. Scott Beamer, Aydın Buluc, David Patterson, "Distributed memory Breadth First Search Revisited: Enabling Bottom Up Search", 2013 IEEE 27th International Symposium on Distributed & Parallel Processing Workshops.
- ix. P. Ajay Kumar Reddy, P. Dileep Kumar, K. Bhaskar reddy, M. Chandra sekhar Reddy, "Black box for vehicles", IJEI Volume 1, issue 7, October 2012, pp 06-12.
- x. Abdallah Kassem, Rabih Jabr, Ghady Salamouni, Ziad Khairallah Maalouf, "Vehicle Black Box System", International Systems Conference Montreal, Canada, April 7-10, 2008
- xi. Artis Mednis y, Leo Selavo y, Atis Elsts y, "Embedded Solution for Road Condition Monitoring Using Vehicular Sensor Network", IEEE, 2012.
- xii. Chulhwa Hong, Truong Le, and Souhwan Jung, Kangsuk Chae, "Evidence Collection from Car Black Boxes using Smartphones", The 8th Annual Consumer Communications and Networking Conference – Demos, 2011.